Space Weather Technical Forecast

Issued on Friday, 10 March 2023 at 12:12 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-class flares (R1-R2/Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the last 24 hours with occasional C-class flares. The largest a C7.1 at 10/0708UTC from AR3245. There are currently 10 numbered sunspots on the visible disc, with AR3245 now the most dominant region. This has shown some weakening of the trailer spots in recent imagery. AR3242 is the other most significant sunspot at present, and has also shown decay in its trailer spots, and is now re-classified as Csi. The remaining regions are generally small, magnetically simple, and either stable or slowly evolving.

A farsided halo CME (coronal mass ejection) observed leaving the Sun during 09 Mar has been analysed, and as expected is directed well away from the Earth. No other Earth directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind speed has slowly declined from 450km/s to near 400km/s. Density was around or below average. Total magnetic field strength was mainly weak, but a brief moderate period was observed between 10/0530-0730UTC, possibly due to a transient weak CME. The north-south component varied weakly between negative and positive levels. Phi angle was mainly negative (towards the Sun) throughout. Geomagnetic activity was mainly Quiet to Unsettled.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 remained at background levels. High energy electron flux (greater than 2MeV) has varied between mainly moderate and high levels, with a peak of 1940pfu at 09/1455UTC. Electron fluence has followed a declining trend, falling to 7.09e7 integrated pfu at 10/0000UTC, and more recently 5.04e7 at 10/1200UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low to Moderate due to two moderately large regions on the visible disc. There is a slight chance of High activity.

Solar Wind / Geomagnetic Activity: No CMEs are forecast to affect the Earth in the next four days. Solar winds are expected to continue near background levels over the next few days, with no further coronal hole HSS connections forecast. Geomagnetic activity is expected to be mostly Quiet to Unsettled (Kp 1-3), throughout the period.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux, as observed by GOES16, is currently at background levels but with a slight chance of reaching S1 or greater should any larger flares occur. High energy electron flux levels (greater than 2MeV) are expected oscillate between moderate and high levels initially, becoming mostly moderate. Electron fluence is expected to continue to decline and remain well below the Active threshold.

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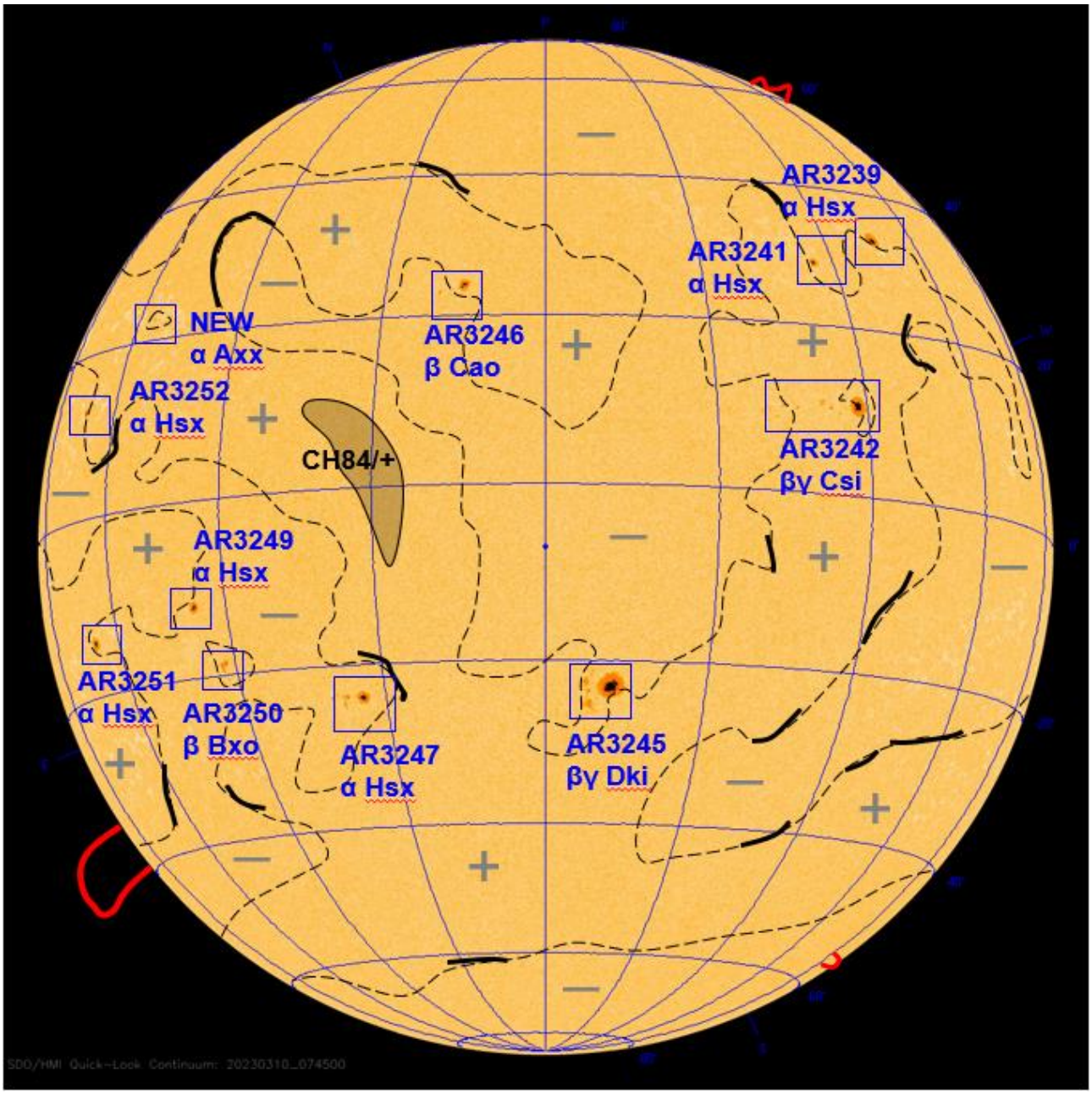
Figure 1. Solar Analysis Valid 10/0800UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A full halo CME which left the sun from beyond the western limb during 09 Mar has been analysed and as expected is directed well away from the Earth.

Coronal hole influence has weakened with solar winds now near background levels. No further coronal holes are expected to affect the earth through the forecast period.
Geomagnetic activity is forecast to be mainly Quiet to Unsettled.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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Radio Blackouts - X-Ray Flares:

Solar activity has been Low through the last 24 hours. The two main spot regions on the disc, AR3242 and AR3245 are both modestly large and responsible for the most recent flares. Both regions are also showing some weakening in their trailing spots. There are eight other numbered spot regions, and these are generally small, magnetically simple, and either stable or slowly evolving.

Low to Moderate activity is forecast with a slight chance of High activity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	10	10	10	10

Solar Radiation Storms - (High Energy Protons):

High energy (greater than 10MeV) proton flux, as observed by GOES16, is currently at background levels. AR3242 and AR3245 pose the most elevated proton risk. AR3242 is in the northwest quadrant, with AR3245 rotating across the southwest. The flare risk has been maintained at a steady level as both spots transit the western hemisphere through the forecast period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	15	15	15	15
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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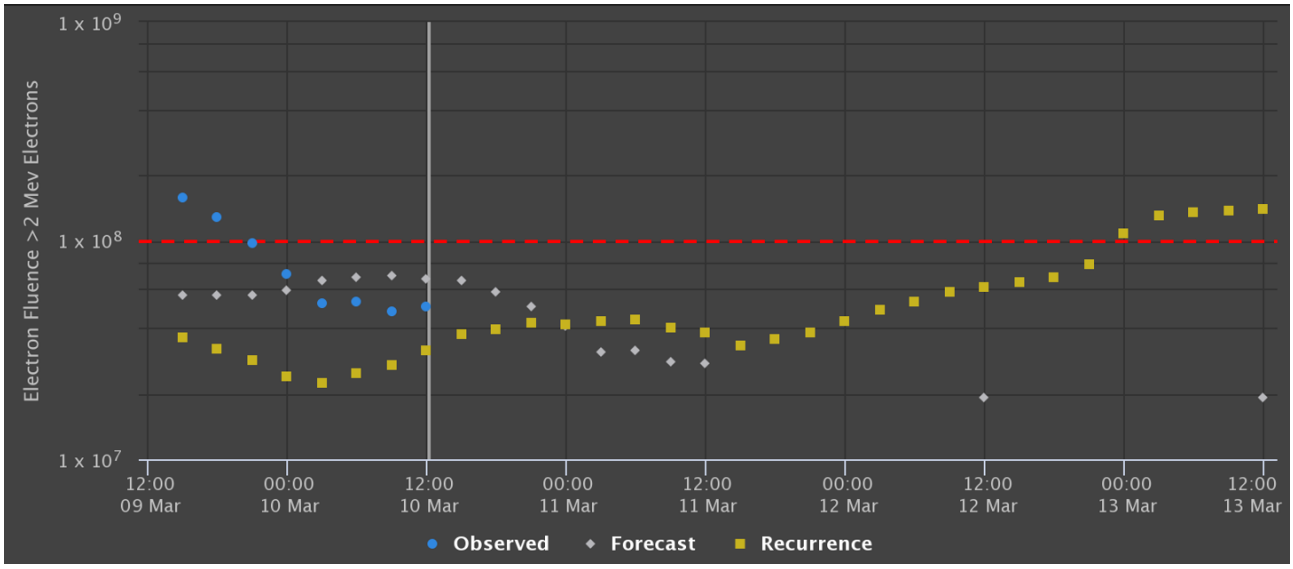
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) has been oscillating between high and moderate levels through the last 24 hours, as the influence of the long-lived high speed streams from coronal holes 81 and 82 wane. In the absence of further coronal holes and with limited geomagnetic activity, electron flux is expected to continue to follow a declining trend through the period, with peaks increasingly likely to be below the high threshold through the period. The BAS radiation belt model is suggesting that there are high electron populations in lower Earth orbits, but with no significant geomagnetic activity forecast and solar wind speeds approaching background levels there appears to be limited mechanisms for the electrons to reach higher orbits.

Electron fluence has dropped significantly and is now comfortably below the Active threshold. Fluence is expected to continue to follow a gradual declining trend through the period, with no inputs or enhancements into the belts forecast from high speed streams or CMEs. The REFM model is considered to be giving a good guide, and probabilities for reaching Active fluence have been reduced accordingly.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	10	5	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 2: MOSWOC REFM latest ouput.



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